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Tsai et al.

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(54) **TORQUE WRENCH**

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(51) **Int. Cl.**
B25B 23/142 (2006.01)

(52) **U.S. Cl.**
USPC **81/478**; 81/467; 81/468; 81/479

(58) **Field of Classification Search**
USPC 81/467, 468, 478, 479
See application file for complete search history.

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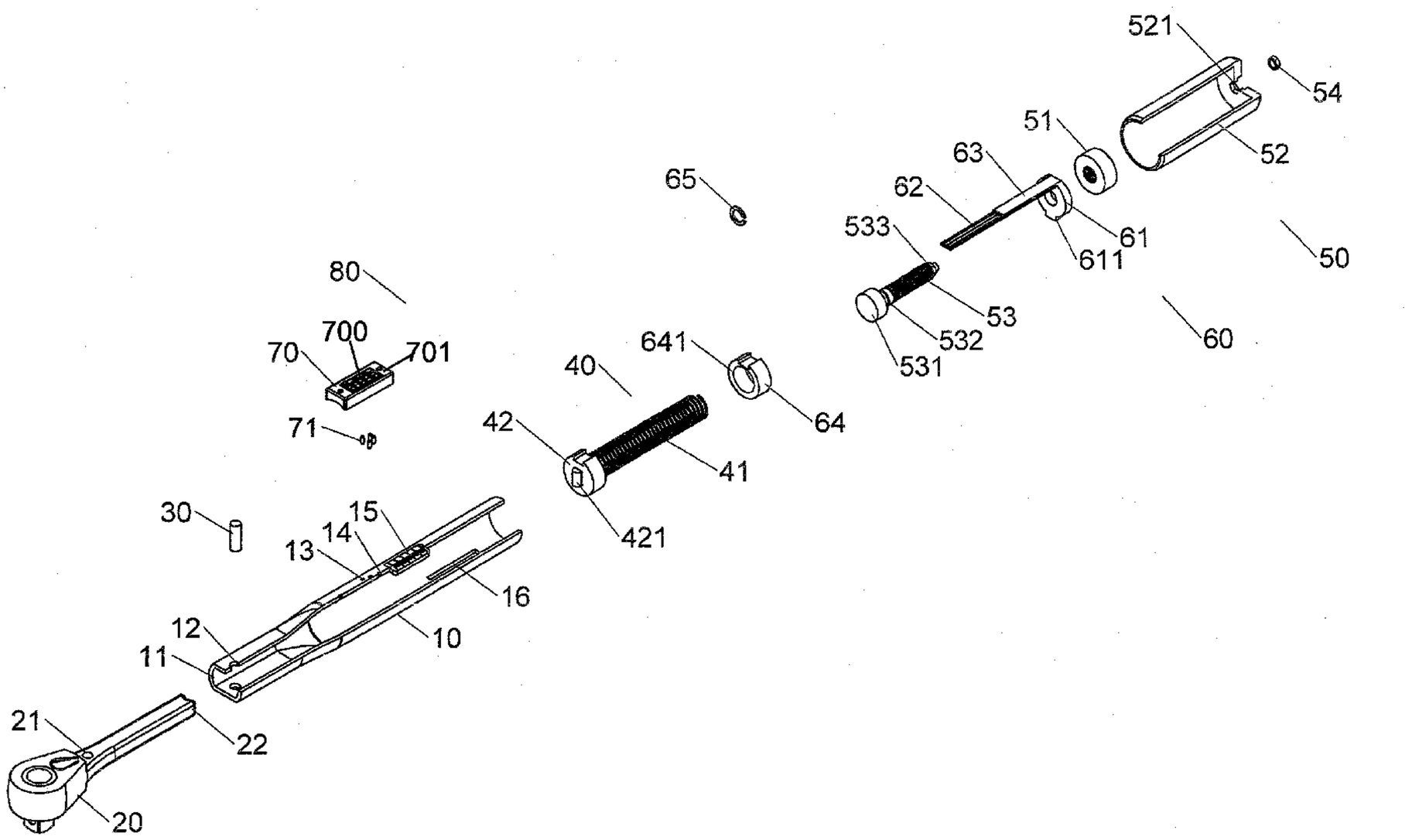
(57) **ABSTRACT**

A torque wrench includes a driving head, a hollow handle, compression unit, an adjustment unit, an index unit and a display unit. The driving head and the handle are pivotably connected to each other. The compression unit has a resilient member and an end piece which contacts the driving head. The adjustment unit adjusts the length of the resilient member to set the torque of the wrench. The index unit has a first index and a second index, both of which are moved with the movement of the adjustment unit. The movement of the first index is detected by the display unit and transferred into digits to display the value of the torque. The second index is cooperated with the marks of the scale member to display the value of the torque.

13 Claims, 16 Drawing Sheets



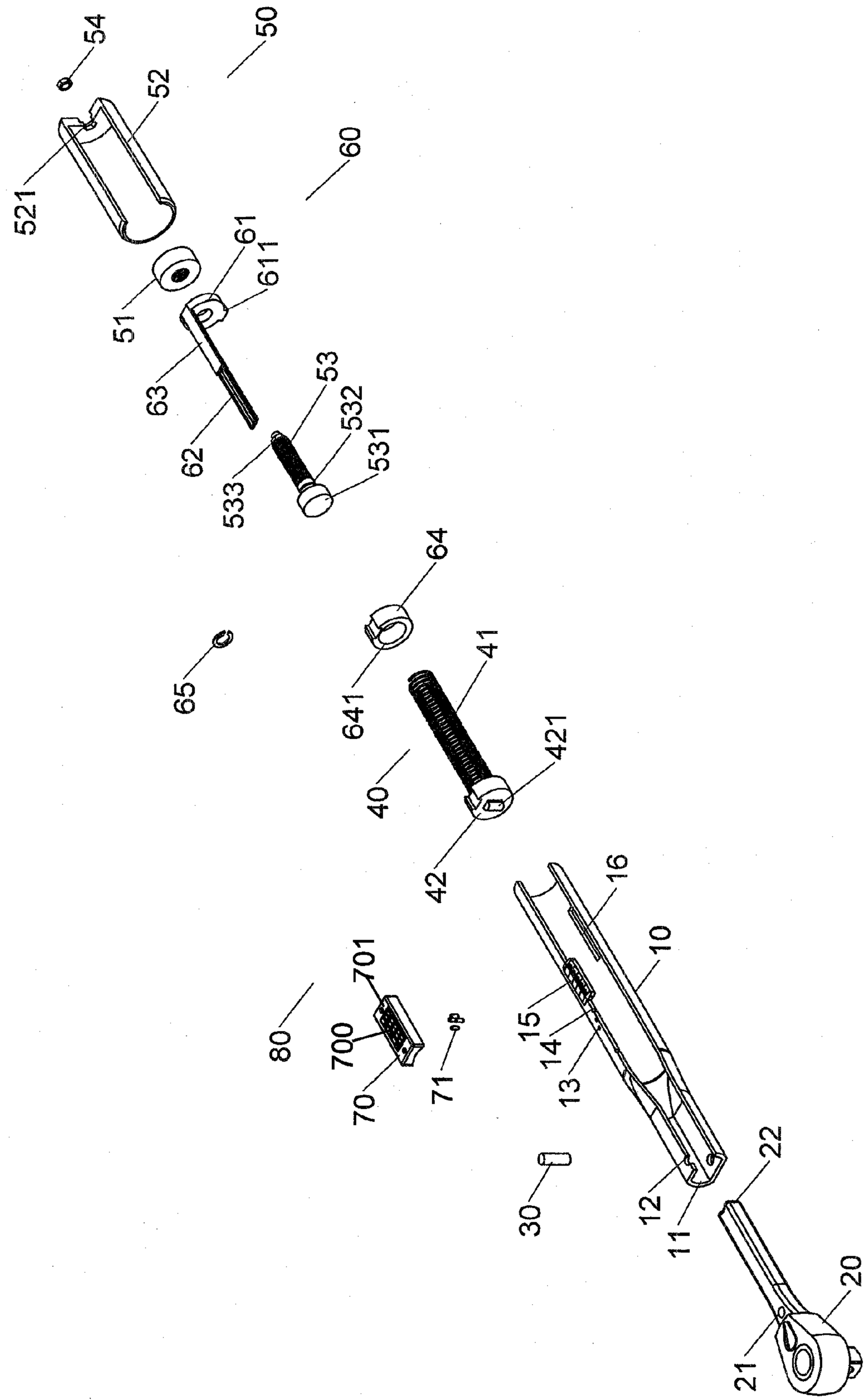

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FIG. 1

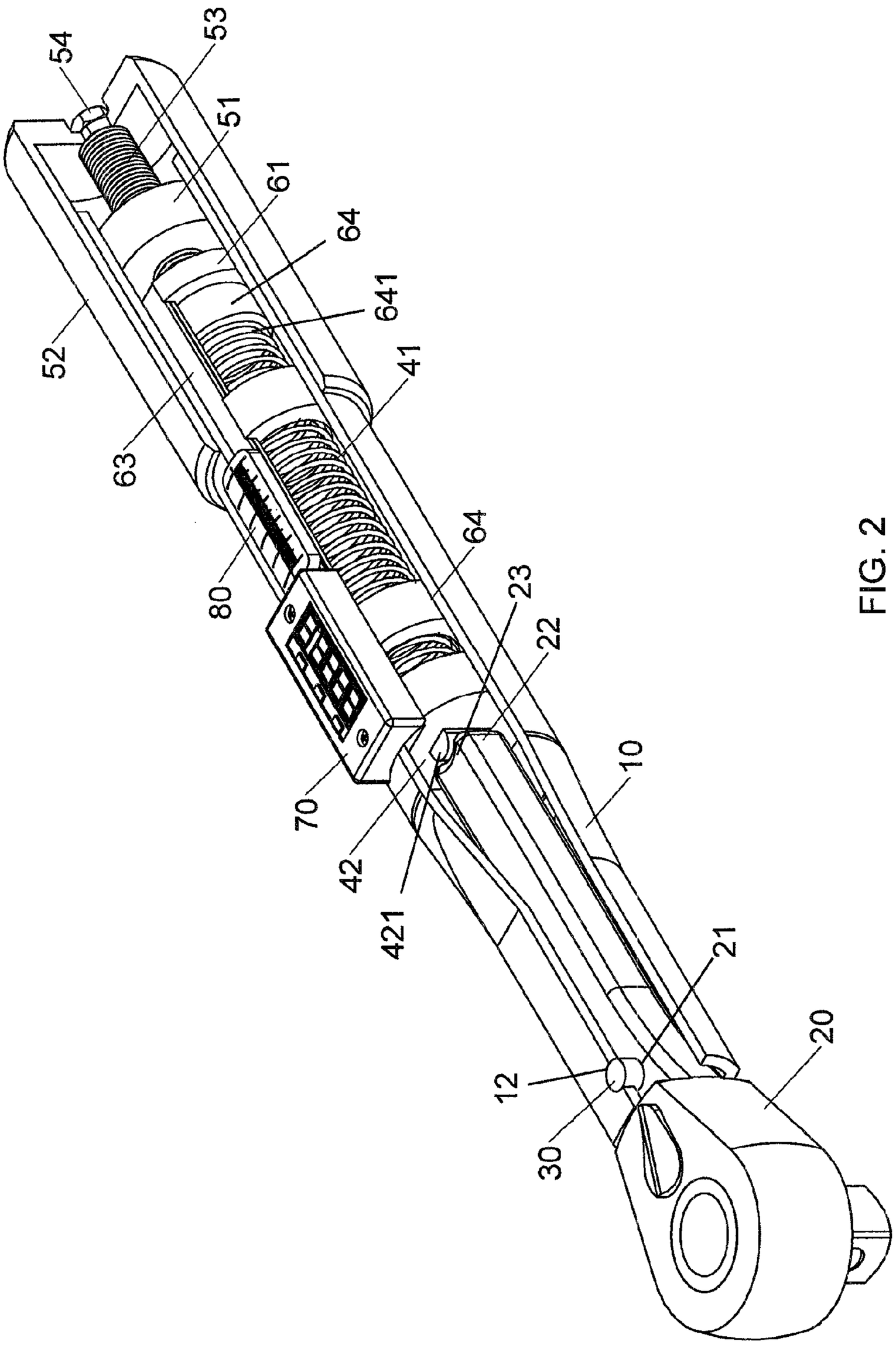

FIG. 2

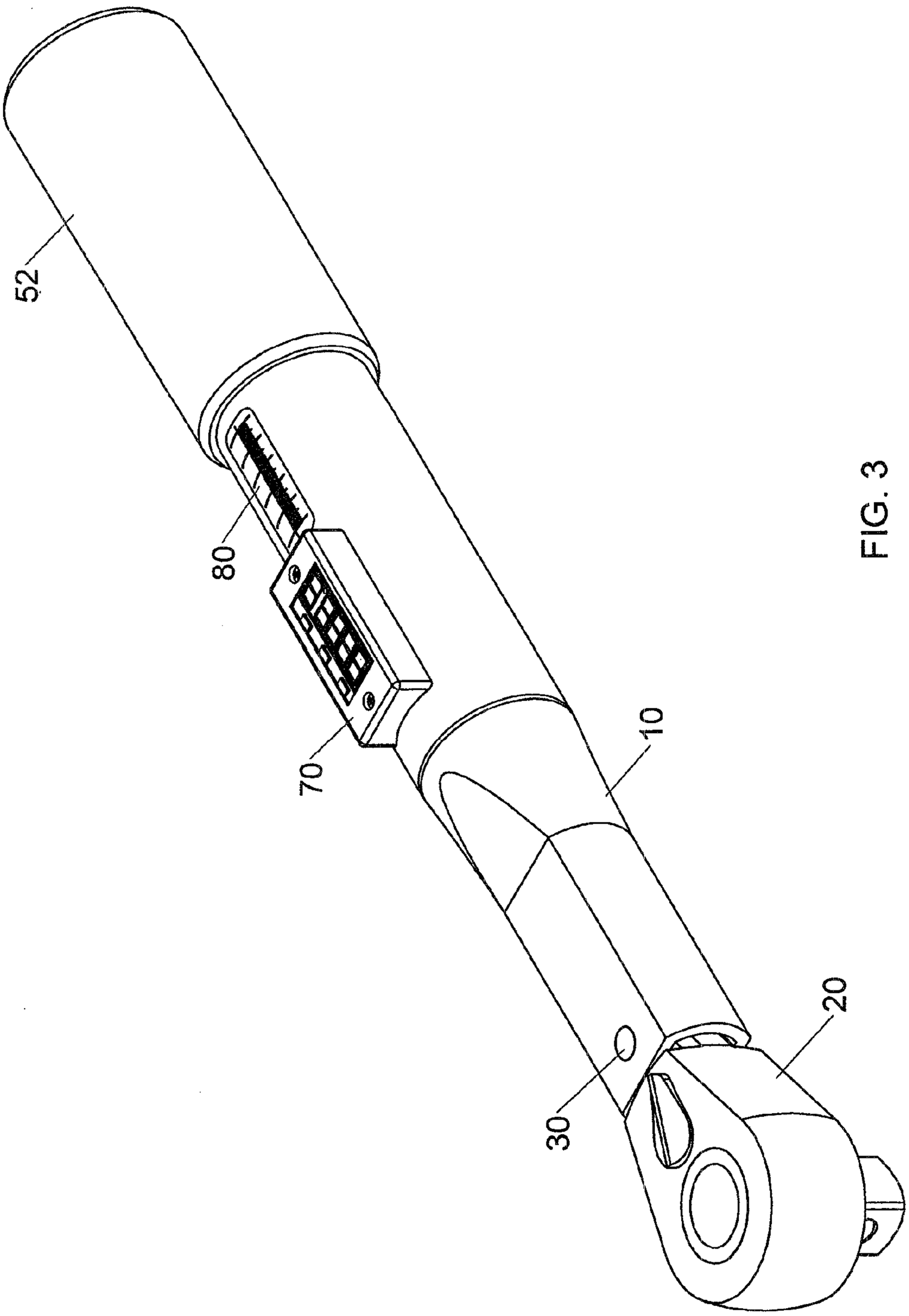

FIG. 3

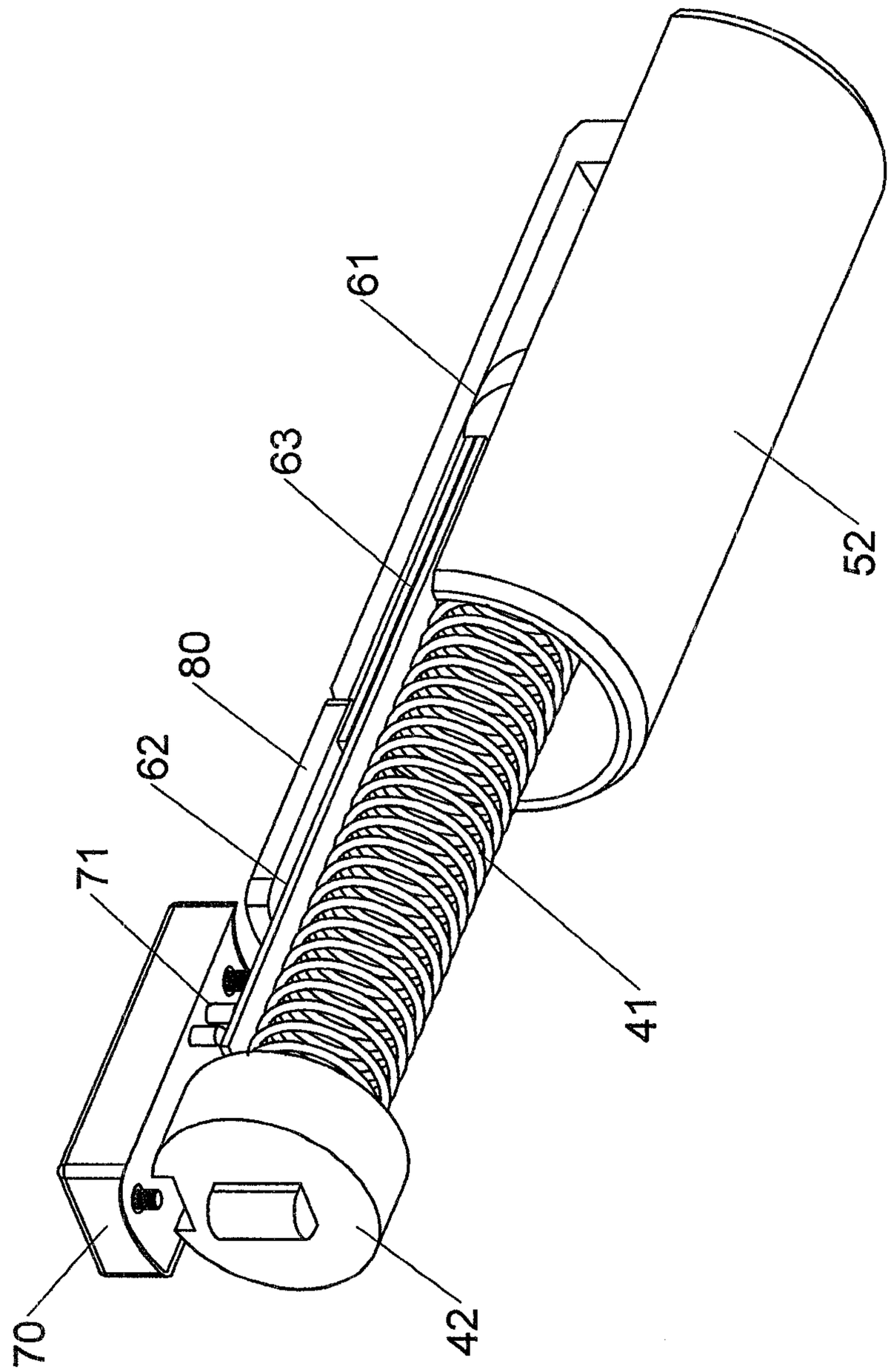

FIG. 4

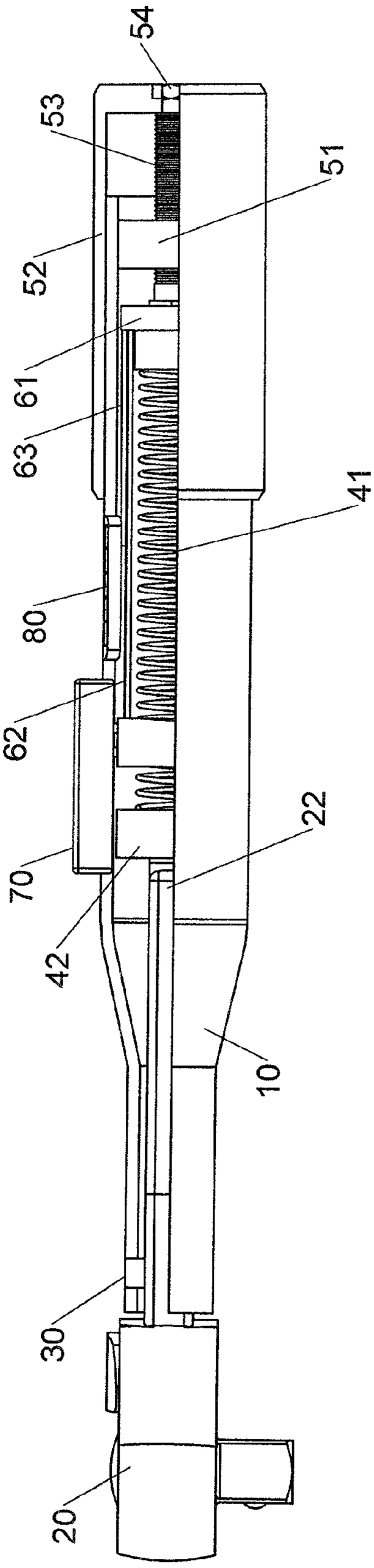

FIG. 5

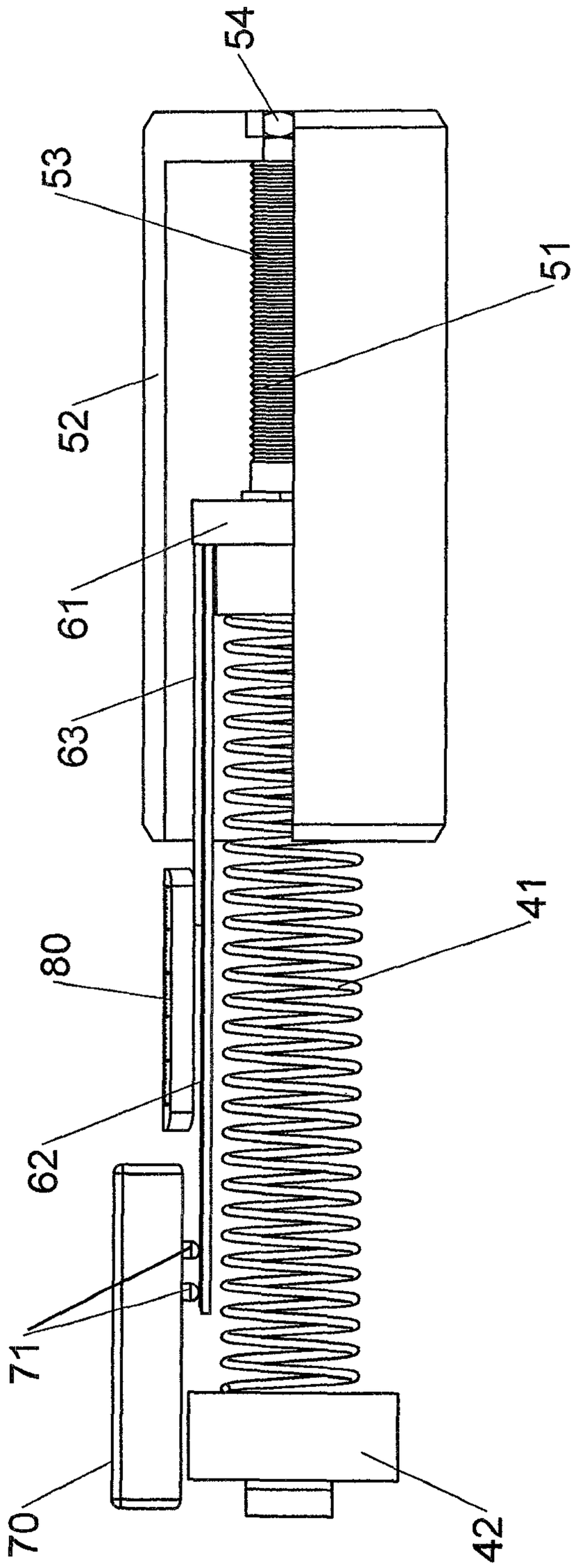

FIG. 6

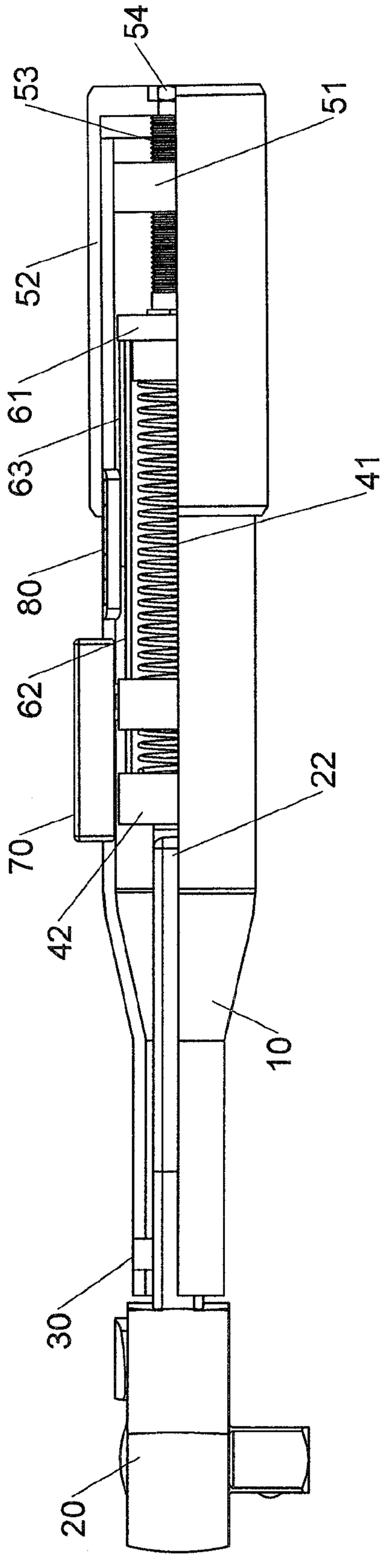

FIG. 7

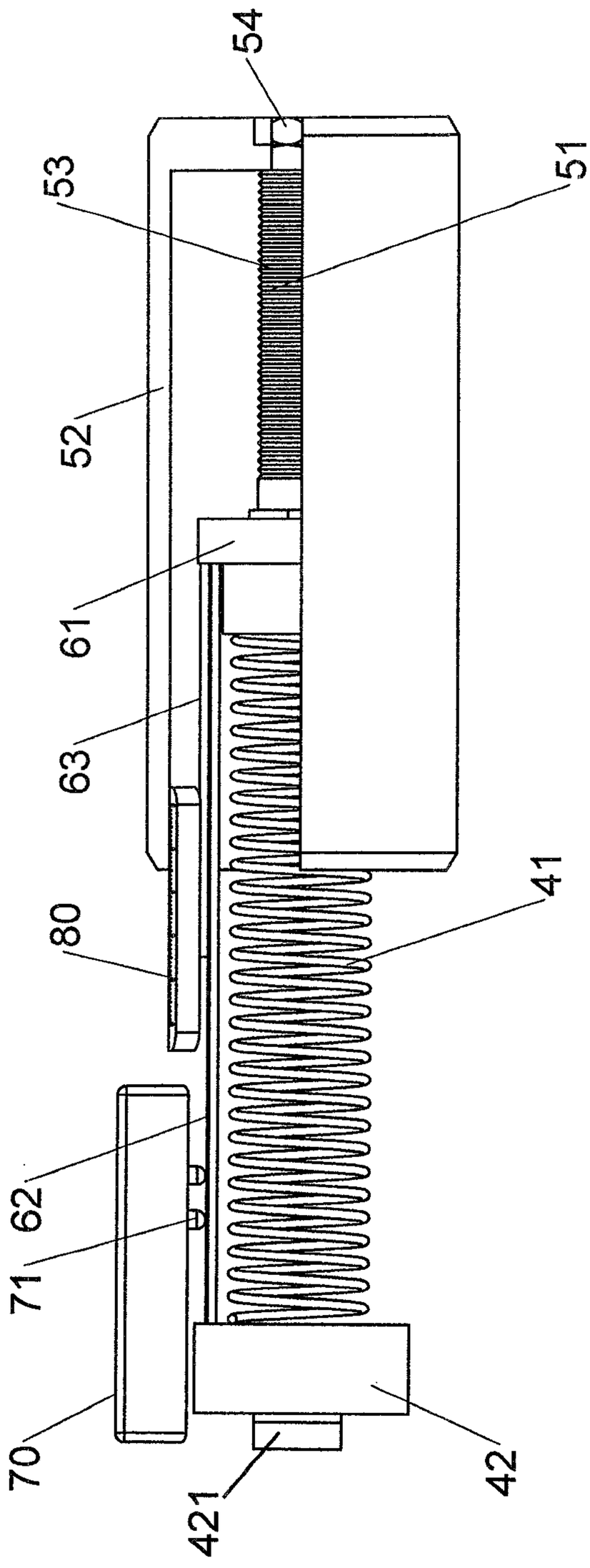

FIG. 8

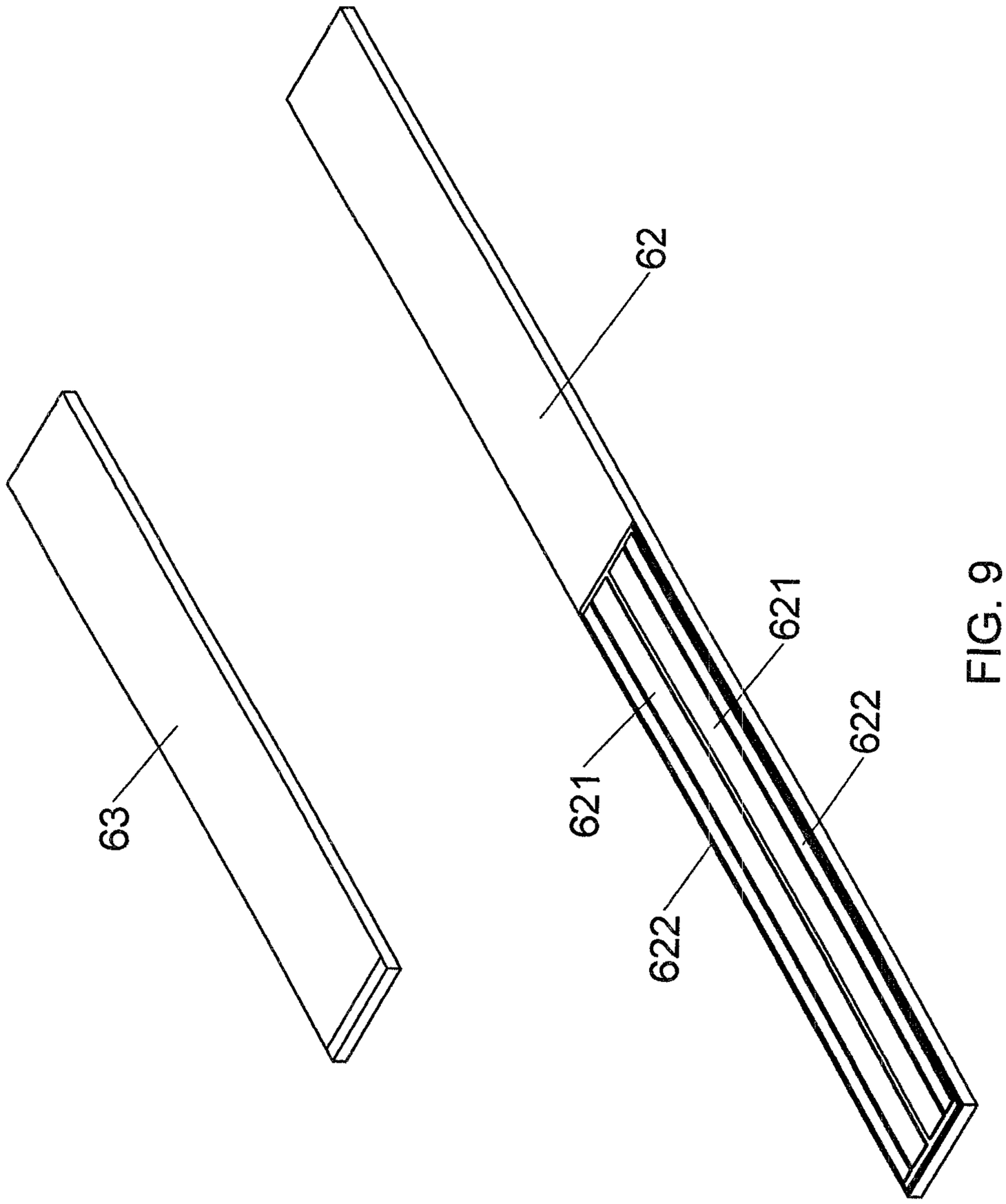

FIG. 9

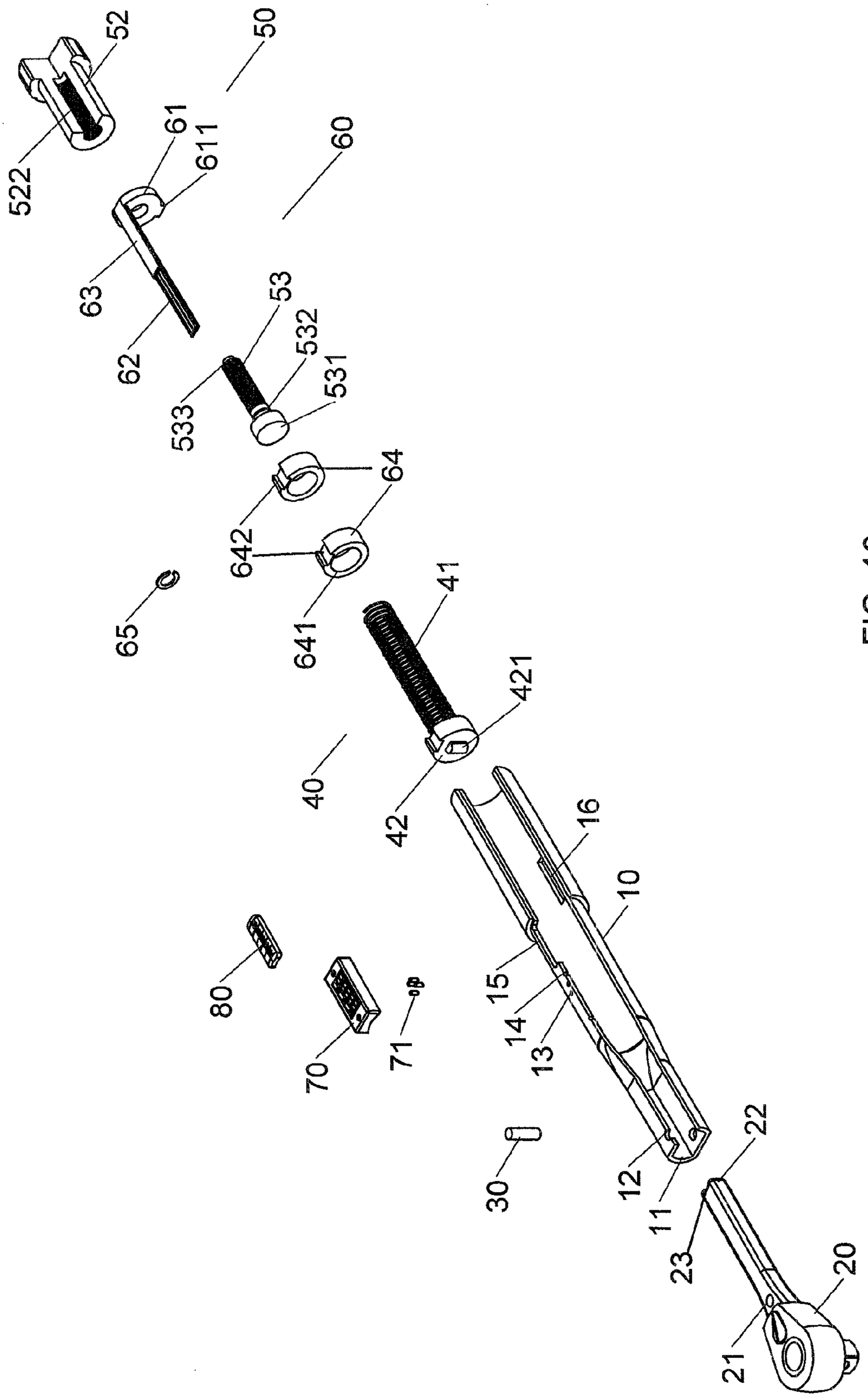
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FIG. 10

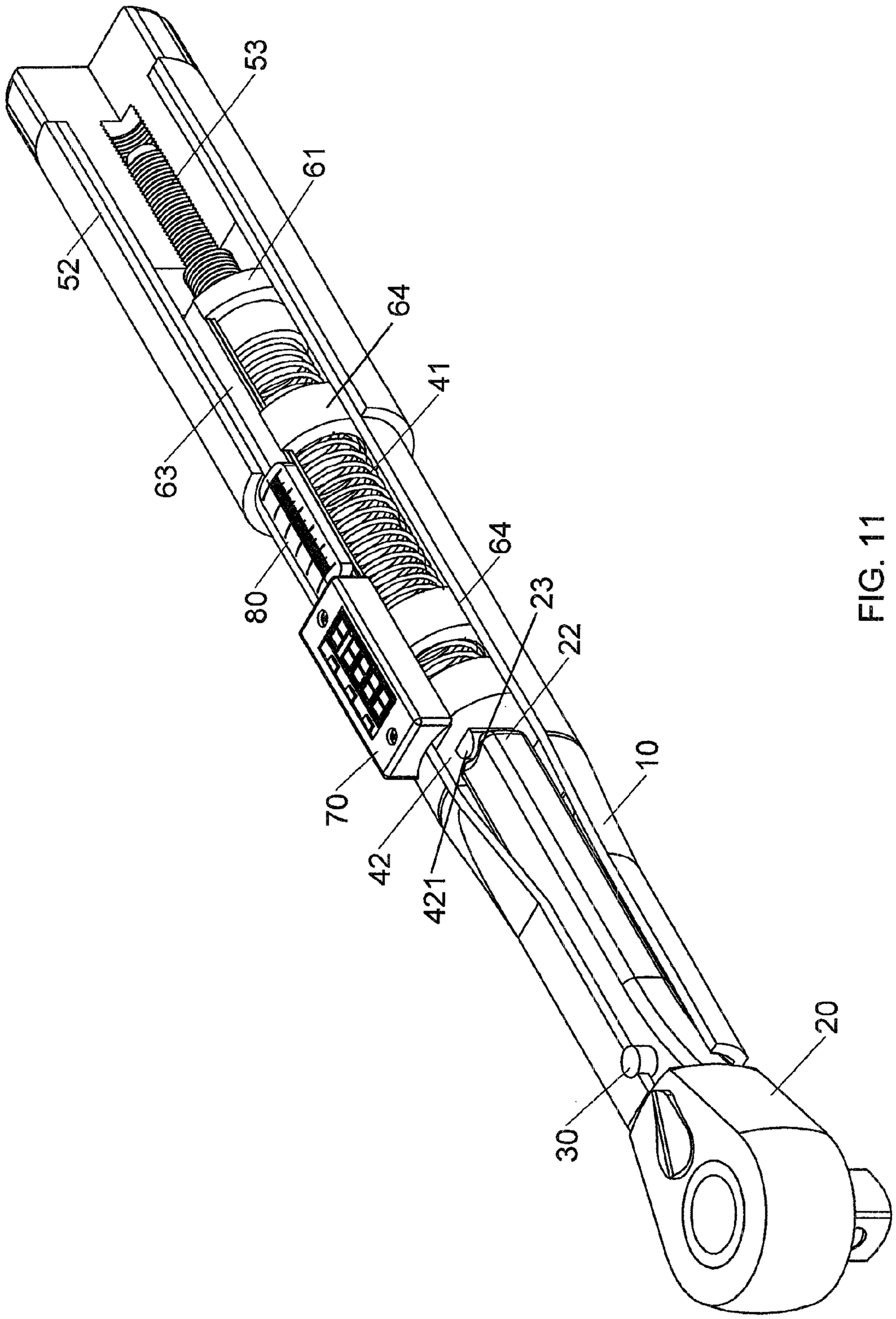

FIG. 11

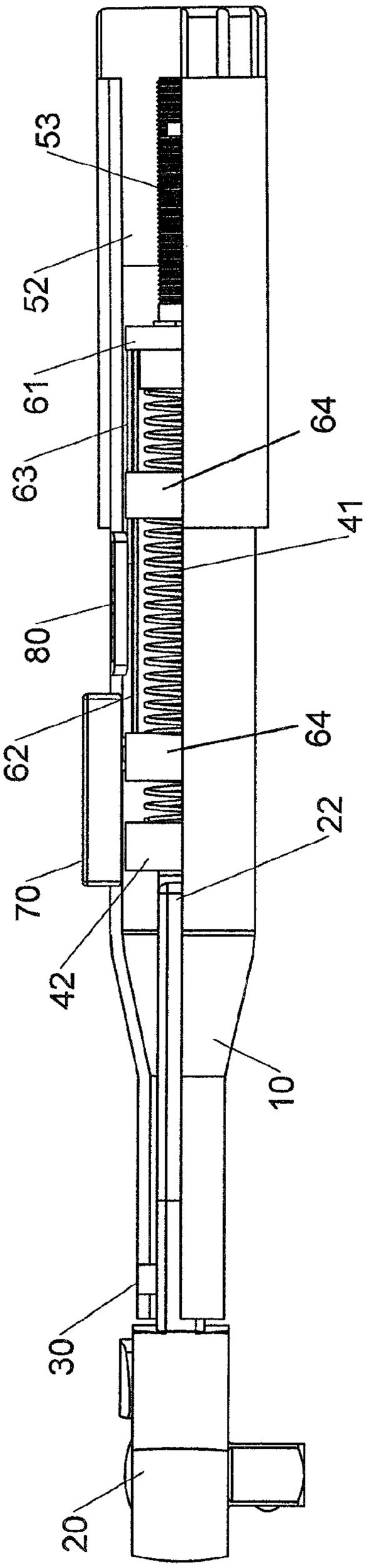

FIG. 12

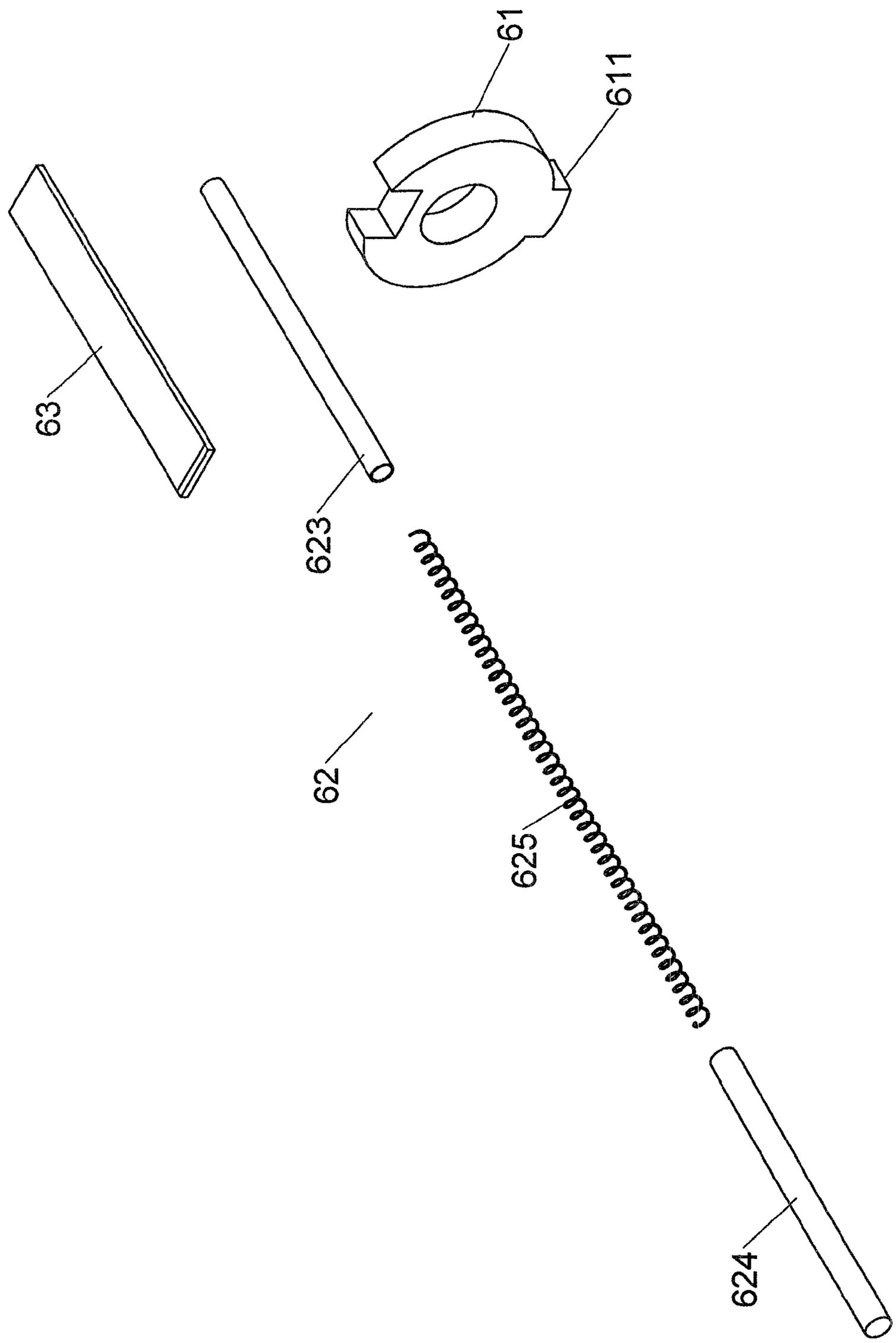

FIG. 13

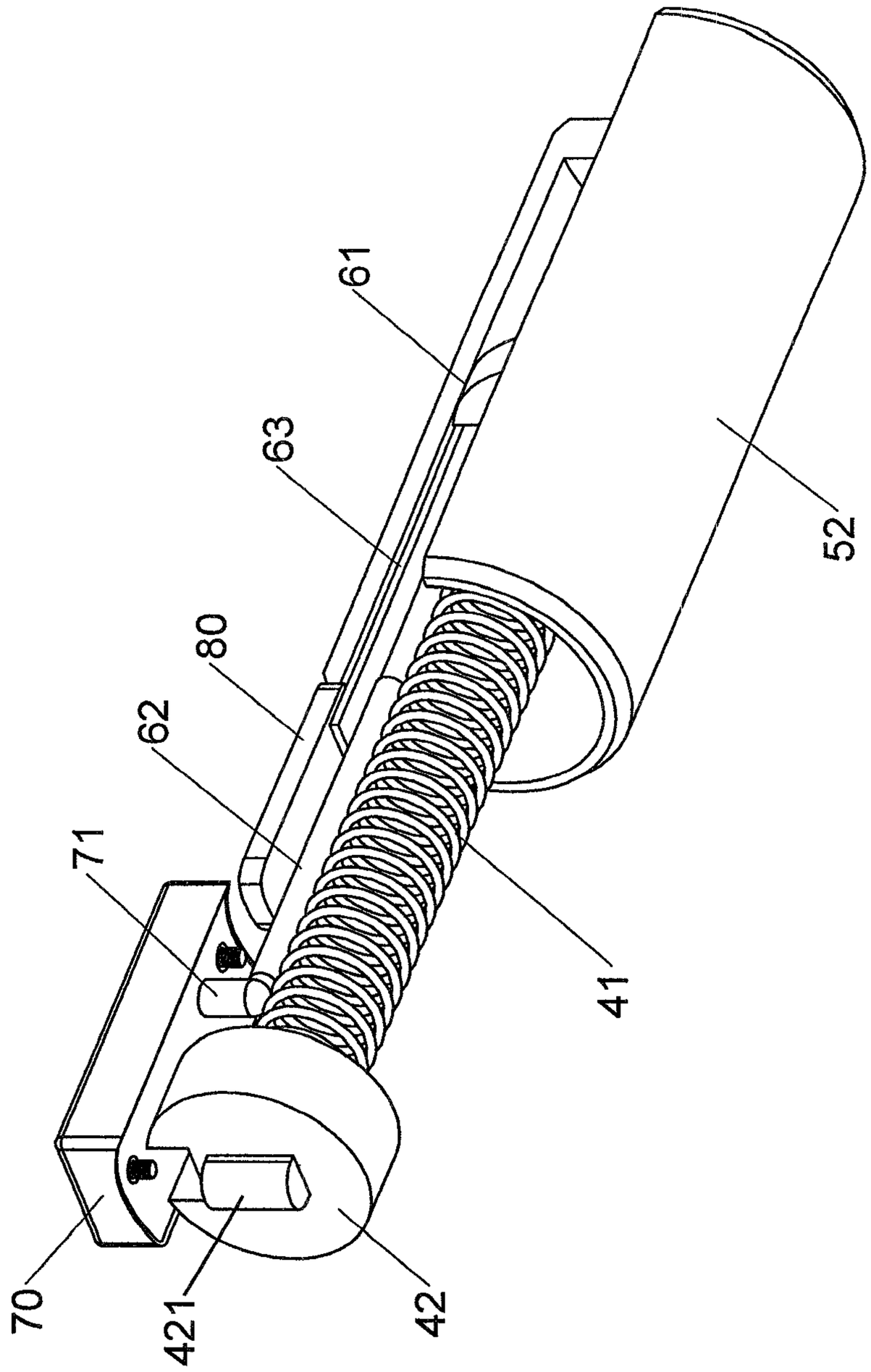

FIG. 14

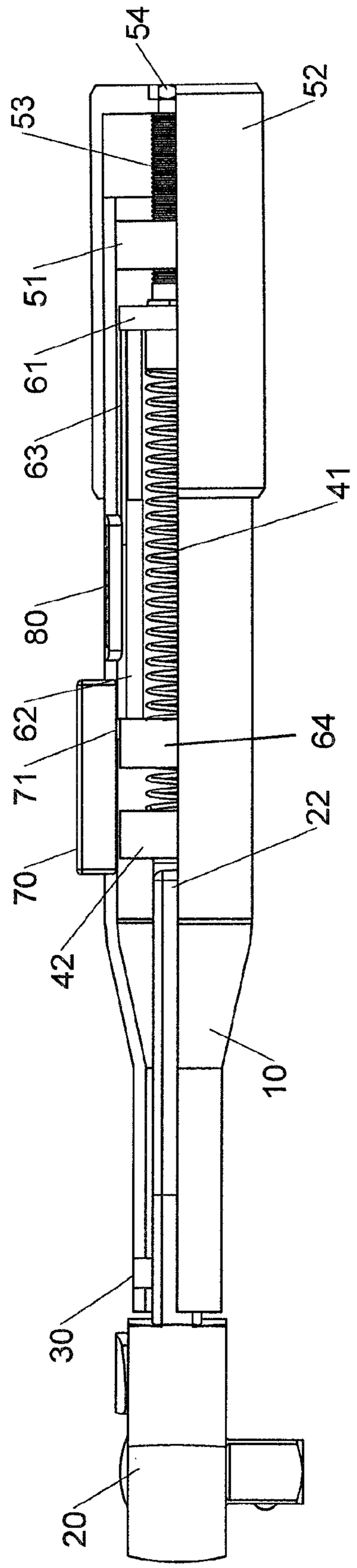

FIG. 15

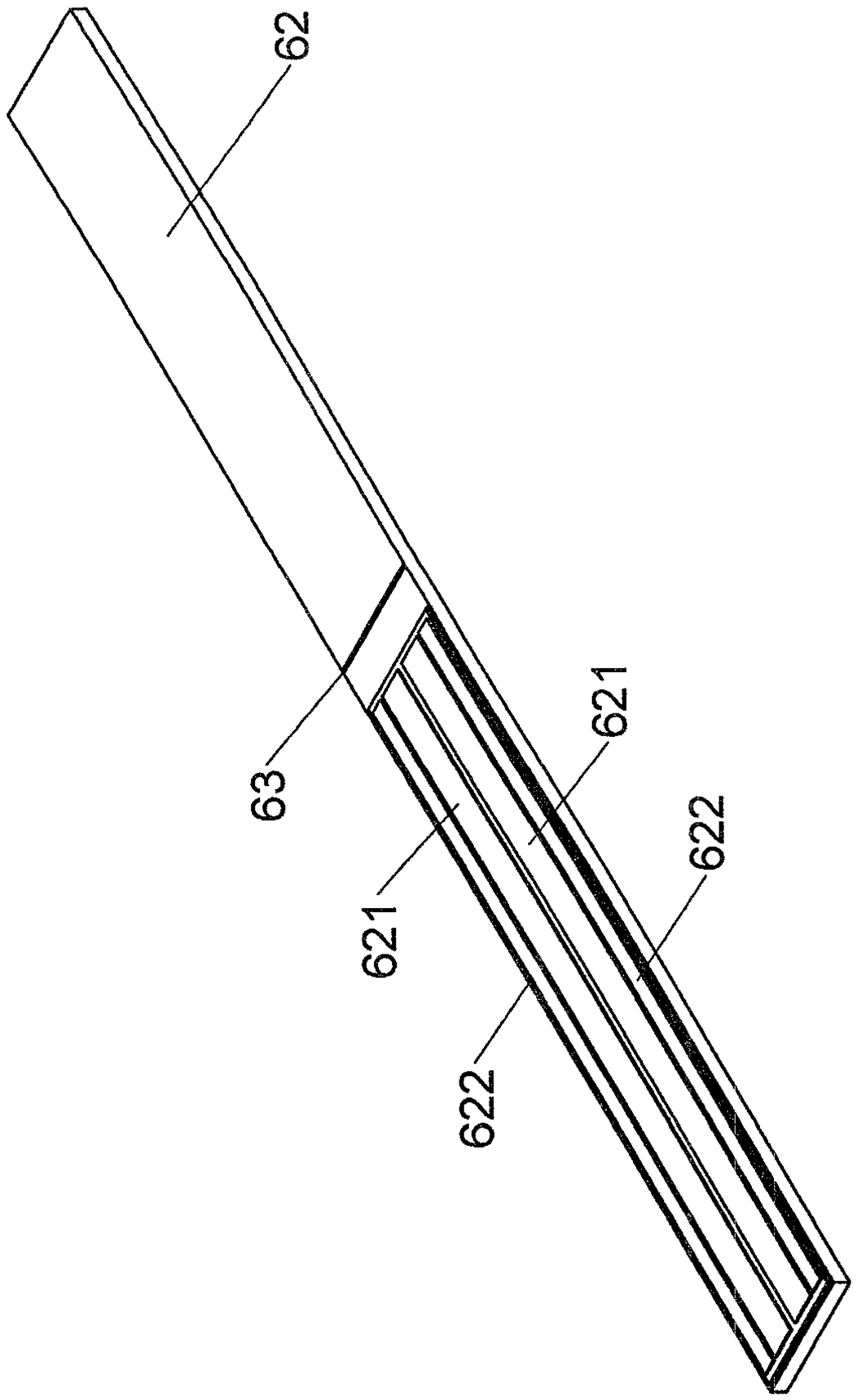

FIG. 16

TORQUE WRENCH

FIELD OF THE INVENTION

The present invention relates to a torque wrench, and more particularly, to a torque wrench having electronic and mechanical display units.

BACKGROUND OF THE INVENTION

A conventional torque wrench is shown in U.S. Pat. No. 7,703,357 and generally includes a ratchet drive portion with an insertion member, a moment arm, a torque-adjustable rod, an in-place-rotatable handle, and a torque setting pointer. A hollow sleeve is fixed at a distal end of the moment arm by a fixing element. An internal toothed portion is formed in a stepped hole of the hollow sleeve and positioned adjacent to one side of the in-place-rotatable handle. The internal toothed portion is, in the normal state, engaged with an external toothed portion of the in-place-rotatable handle by means of an elastic element located between the in-place-rotatable handle and the hollow sleeve. The elastic element has one end abutting the stepped hole of the hollow sleeve. The torque-adjustable rod of a torque adjusting mechanism is driven by the in-place-rotatable handle for adjusting the torque value when the in-place-rotatable handle is pushed in the direction of the hollow sleeve so as to disengage the internal and external toothed portions from each other, thereby achieving an expected adjustment. After the adjustment, the external force is released and the internal and external toothed portions are automatically restored in an engaged and locked position of the normal state by means of the self-resilience of the elastic element. The drawbacks of the torque wrench is that when the in-place-rotatable handle is rotated to drive the torque-adjustable rod, the torque setting pointer is moved so that the pointer points a certain value mark to show the pre-set value of the torque. However, the pointer and the marks are so small and the user has to check carefully the relative positions therebetween and this is difficult especially when the illumination condition is poor.

Another conventional torque wrench is disclosed in U.S. Pat. No. 7,685,889 and generally includes a body portion positioned between a handle portion and a driving portion. The driving portion has a driving head to drive the object by pre-set torque. The handle portion has a certain length for the users to hold and a space is provided in the body portion for installing an electronic mechanism inside the body portion. The electronic mechanism has a volume for installing at least two electronic units therein and the electronic units are stacked to reduce the space required so that more electronic units can be installed to have multiple functions. Nevertheless, the electronic units need batteries to function and once the power from the batteries is gone, the display function fails.

The present invention intends to provide a torque wrench having electronic and mechanical display units.

SUMMARY OF THE INVENTION

The present invention relates to a torque wrench includes a driving head, a hollow handle, compression unit, an adjustment unit, an index unit and a display unit. The driving head and the handle are pivotably connected to each other. The compression unit has a resilient member and an end piece which contacts the driving head. The adjustment unit adjusts the length of the resilient member to set the torque of the wrench. The index unit has a first index and a second index,

both of which are moved with the movement of the adjustment unit. The movement of the first index is detected by the display unit and transferred into digits to display the value of the torque. The second index is cooperated with the marks of the scale member to display the value of the torque.

The primary object of the present invention is to provide a torque wrench having electronic and mechanical display units to show the torque in two different ways.

The present invention will become more obvious from the following description when taken in connection with the accompanying drawings which show, for purposes of illustration only, a preferred embodiment in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exploded view to show the torque wrench of the present invention;

FIG. **2** is a perspective view to show the torque wrench of the present invention, wherein the handle and the outer tube are partially removed;

FIG. **3** is a perspective view to show the torque wrench of the present invention;

FIG. **4** is a perspective view to show the relative positions between the movement sensor and the first index, and between the scale member and the second index;

FIG. **5** shows the side view of the torque wrench of the present invention;

FIG. **6** is an enlarged view to show a part of the torque wrench in FIG. **5**;

FIG. **7** shows the operational status of torque wrench;

FIG. **8** shows the index unit in FIG. **7**;

FIG. **9** shows the first index and second index of the index unit;

FIG. **10** is an exploded view to show the second embodiment of the torque wrench of the present invention;

FIG. **11** is a perspective view to show the torque wrench of the present invention as shown in FIG. **10**;

FIG. **12** is a side view of the torque wrench of the present invention as shown in FIG. **10**;

FIG. **13** shows the first index, the second index and the second piece of the third embodiment of the torque wrench of the present invention as shown in FIG. **10**;

FIG. **14** is a perspective view to show a part of the third embodiment of the torque wrench of the present invention;

FIG. **15** is a side view of the third embodiment of the torque wrench of the present invention, and

FIG. **16** shows the fourth embodiment of the torque wrench of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1-6**, the torque wrench of the present invention comprises a hollow handle **10** having a space **11** defined therein. Four first recesses **13** and one second recess **15** are defined in the handle **10**. A first hole **12** defined transversely through the handle **10** and an elongate guide slot **16** and at least two fixing holes **14** are also defined in the handle **10**. The first hole **12**, the four first recesses **13**, the second recess **15** and the elongate guide slot **16** communicate with the space **11**. The first recesses **13** are located between two fixing holes **14**. The second recess **15** and the elongate guide slot **16** are located on two opposite sides of the handle **10**.

A driving head **20** has a shank **22** extending therefrom which has a ratchet mechanism and an engaging portion. The engaging portion is engaged with an object. The shank **22** is

inserted into the space **11** and pivotably connected to the handle **10** by a pin **30** extending through the first hole **12** and the second hole **21**. The shank **22** is pivotable within the space **11**. The shank **22** has a curved notch **23** defined in the distal end thereof.

A compression unit **40** is located in the space **11** and has a resilient member **41** and end piece **42**. The resilient member **41** has a first end contacting the end piece **42** and the end piece **42** has a curved protrusion **421** extending from the center of its end face and the curved protrusion **421** is engaged with the curved notch **23**. The resilient member **41** is indirectly in contact with the driving head **20**.

An adjustment unit **50** is connected to the handle **10** to adjust the resilient member **41** to reach a pre-set value of torque of the driving head **20**. The adjustment unit **50** comprises a fixing block **51**, an outer tube **52**, an adjustment rod **53** and a clip **54**. The fixing block **51** is fixed in the space **11** and located on a side of the guide slot **16** and close to the end opposite to the driving head **20** of the handle **10**. The fixing block **51** includes a threaded hole **510** defined centrally therethrough. The outer tube **52** has an open end so as to be rotatably mounted to the handle **10** and the other end of the outer tube **52** has a hexagonal hole **521** defined centrally therethrough. The adjustment rod **53** has a threaded section which is engaged with the threaded hole **510**. A first piece **531** is connected to an end of the threaded section and contacts the second end of the resilient member **41**. The adjustment rod **53** has a groove **532** defined in an outer surface thereof. The first piece **531** has a hexagonal block **533** extends from a distal end of the threaded section and is engaged with the hexagonal hole **521**. The clip **54** is engaged with a distal end of the threaded section to connect the outer tube **52** to the adjustment rod **53**. When the outer tube **52** is rotated relative to the handle **10**, the fixing block **51** is stationary so that the outer tube **52** drives the adjustment rod **53** to move axially along the handle **10** to change the length of the resilient member **41** and move the second piece **61** to set the torque.

An index unit **60** is movable axially along with the length change of the resilient member **41** and has a second piece **61**, a first index **62**, a second index **63**, at least one ring **64** and a clip **65**. The second piece **61** has a positioning member **611** which is located in the guide slot **16**. When the adjustment rod **53** is rotated and moved relative to the handle **10**, the positioning member **611** and the second piece **61** are moved linearly along with the adjustment rod **53**. The second piece **61**, the first index **62** and the second index **63** are an integral part and movable longitudinally with a length change of the resilient member **41**. The second index **63** is located above the first index **62**, and the first index **62** is longer than the second index **63**. The ring **64** has a through hole **641** defined centrally therethrough and the resilient member **41** is inserted into the through hole **641**. There are two rings **64** and each has a slot **642** defined in the outer surface thereof so that the first index **62** is movably engaged with the slot **642**. The clip **65** is engaged with the groove **532** of the adjustment rod **53** to restrict the second piece **61** to movably mount to the adjustment rod **53**.

A display unit **70** is fixed to the fixing hole **14** of the handle **10** and has a display member **700**, a calculation member **701** and four movement sensors **71**. Each movement sensor **71** is located in the first recess **13**. The movement sensors **71** detect the movement distance of the first index **62** and generates a signal which is calculated by the calculation member and transferred into a torque value displayed in the display member.

A scale member **80** is a transparent or semi-transparent member and has marks thereon. The scale member **80** located in the second recess **15** of the handle **10** and correspondent to the second index **63**. The mark on the scale member **80** pointed by the second index **63** is the torque value.

When the first index **62** and the second index **63** respectively point the pre-set torque value of the display unit **70** and the scale member **80**, the user may rotate the object by the driving head **20**. When the output torque that the driving head **20** applies to the object reaches the pre-set torque value, the curved protrusion **421** is disengaged from the curved notch **23** to protect the object and the wrench.

As shown in FIGS. **7** and **8**, when the user rotates the outer tube **52** to rotate and move the adjustment rod **53**, the first piece **531** compresses the resilient member **41** to provide torque to the wrench. The movement sensors **71** detect the movement of the first index **62** to show the torque value, and the second index **63** points the mark on the scale member **80** to show the torque value.

As shown in FIG. **9**, the first index **62** has multiple parallel first lines **621** and second lines **622**, the first and the second lines **621**, **622** are detected by the movement sensors **71**.

As shown in FIGS. **10** to **12**, the adjustment rod **53** can only be moved in the handle **10** and the outer tube **52** is rotatable connected to the end of the handle **10**. The outer tube **52** is rotatably mounted to the handle **10** and has a threaded hole **522**. The adjustment rod **53** has the threaded section engaged with the threaded hole **522**. When the outer tube **52** is rotated relative to the handle **10**, the adjustment rod **53** and the first piece **531** move axially to change the length of the resilient member **41** and move the second piece **61**. The first and second indexes **62**, **63** are moved along with the adjustment rod to show the torque value.

As shown in FIGS. **13** to **15**, the first index **62** can be a retractable tube and includes a first tube **623**, a second tube **624** and a resilient member **625**. The first and second tubes **623**, **624** are connected to each other, and the resilient member **625** contacts between the first and second tubes **623**, **624** so that the length of the first and second tubes **623**, **624** can be adjusted. The first tube **623** has an end fixed to the top of the second piece **61** and the second tube **624** has one end contacting the movement sensor **71** which detects the force from the first index **62** or the length of the first and second tubes **623**, **624** to show the torque value on the display unit **70**.

As shown in FIG. **16**, the fourth embodiment of the present invention shows that the first and second indexes **62**, **63** are integrally connected to each other and the first index **62** has value marks which are matched with the marks on the scale member **80**.

The torque wrench of the present invention can adjust the resilient member **41** by the adjustment unit to set the torque that disengages the curved protrusion **421** from the curved notch **23**. The first index is moved with the movement of the adjustment rod **53** and the movement sensors **71** detect the movement distance to show the torque value. The index unit **60** includes the first index **62** and the second index **63**, wherein the first index **62** shows the torque by digits and the second index **63** shows the torque by cooperation with the scale member **80**. Therefore, the torque wrench includes both electronic and mechanical displays. In other words, if the display unit **70** fails, the mechanical display can show the torque.

While we have shown and described the embodiment in accordance with the present invention, it should be clear to those skilled in the art that further embodiments may be made without departing from the scope of the present invention.

What is claimed is:

1. A torque wrench comprising:

a hollow handle having a space defined therein;

a driving head having a shank extending therefrom which is inserted into the space, the shank pivotably connected to the handle by a pin and the shank being pivotable within the space;

a compression unit located in the space and having a resilient member and end piece, the resilient member having a first end contacting the end piece and the end piece contacting a distal end of the shank;

an adjustment unit connected to the handle to adjust the resilient member to reach a torque value of the driving head; the adjustment unit has an outer tube and an adjustment rod which is movably located in the handle, the outer tube is rotatably mounted to the handle and has a threaded hole, the adjustment rod has a threaded section which is engaged with the threaded hole, when the outer tube is rotated relative to the handle, the adjustment rod moves axially to change a length of the resilient member and move the second piece;

an index unit having a second piece, a first index and a second index, the second piece, the first index and the second index being an integral part and movable longitudinally with a length change of the resilient member;

a display unit fixed to the handle and having a display member, a calculation member and at least one movement sensor which detects a movement distance of the first index and generates a signal which is calculated by the calculation member and transferred into a torque value displayed in the display member, and

a scale member being a transparent member and having marks thereon, the scale member located to the handle and corresponding to the second index, the mark being pointed by the second index being the torque value.

2. The torque wrench as claimed in claim **1**, wherein there are four movement sensors and the first index has multiple parallel first lines and second lines, the first and the second lines are detected by the movement sensors.

3. The torque wrench as claimed in claim **1**, wherein the handle has at least one ring fixed therein and the at least one ring has a slot defined in an outer surface thereof and the first index movably engaged with the slot, the resilient member extends through the at least one ring.

4. The torque wrench as claimed in claim **1**, wherein the first index has value marks which are matched with the marks on the scale member.

5. The torque wrench as claimed in claim **1**, wherein the second index is located above the first index.

6. The torque wrench as claimed in claim **1**, wherein the handle includes a guide slot and the second piece is movably mounted to the adjustment rod, the second piece has a positioning member which is located in the guide slot.

7. The torque wrench as claimed in claim **6**, wherein the adjustment rod has a groove defined in an outer surface thereof and a clip is engaged with the groove to contact the second piece so that the second piece is movably mounted to the adjustment rod.

8. A torque wrench comprising:

a hollow handle having a space defined therein;

a driving head having a shank extending therefrom which is inserted into the space, the shank pivotably connected to the handle by a pin and the shank being pivotable within the space

a compression unit located in the space and having a resilient member and end piece, the resilient member having a first end contacting the end piece and the end piece contacting a distal end of the shank;

an adjustment unit connected to the handle to adjust the resilient member to reach a torque value of the driving head; the adjustment unit has a fixing block, an outer tube, an adjustment rod and a clip, the fixing block is fixed in the space and includes a threaded hole defined centrally therethrough, the outer tube is rotatably mounted to the handle and has an end with a hexagonal hole defined centrally therethrough, the adjustment rod has a threaded section which is engaged with the threaded hole, a first piece is connected to an end of the threaded section and contacts a second end of the resilient member, the first piece has a hexagonal block extends from a distal end of the threaded section and is engaged with the hexagonal hole, the clip is engaged with a distal end of the threaded section to connect the outer tube to the adjustment rod, when the outer tube is rotated relative to the handle, the adjustment rod moves axially to change a length of the resilient member and move the second piece;

an index unit having a second piece, a first index and a second index, the second piece, the first index and the second index being an integral part and movable longitudinally with a length change of the resilient member;

a display unit fixed to the handle and having a display member, a calculation member and at least one movement sensor which detects a movement distance of the first index and generates a signal which is calculated by the calculation member and transferred into a torque value displayed in the display member, and

a scale member being a transparent member and having marks thereon, the scale member located to the handle and corresponding to the second index, the mark being pointed by the second index being the torque value.

9. The torque wrench as claimed in claim **8**, wherein the handle includes a guide slot and the second piece is movably mounted to the adjustment rod, the second piece has a positioning member which is located in the guide slot.

10. The torque wrench as claimed in claim **9**, wherein the adjustment rod has a groove defined in an outer surface thereof and a clip is engaged with the groove to contact the second piece so that the second piece is movably mounted to the adjustment rod.

11. A torque wrench comprising:

a hollow handle having a space defined therein; the handle has at least one ring fixed therein and the at least one ring has a slot defined in an outer surface thereof;

a driving head having a shank extending therefrom which is inserted into the space, the shank pivotably connected to the handle by a pin and the shank being pivotable within the space;

a compression unit located in the space and having a resilient member and end piece, the resilient member having a first end contacting the end piece and the end piece contacting a distal end of the shank;

an adjustment unit connected to the handle to adjust the resilient member to reach a torque value of the driving head;

an index unit having a second piece, a first index and a second index, the second piece, the first index and the second index being an integral part and movable longitudinally with a length change of the resilient member; the first index movably engaged with the slot of the at least one ring; the resilient member extends through the at least one ring

a display unit fixed to the handle and having a display member, a calculation member and at least one movement sensor which detects a movement distance of the first index and generates a signal which is calculated by

the calculation member and transferred into a torque value displayed in the display member, and

a scale member being a transparent member and having marks thereon, the scale member located to the handle and corresponding to the second index, the mark being pointed by the second index being the torque value.

12. The torque wrench as claimed in claim **11**, wherein there are four movement sensors and the first index has multiple parallel first lines and second lines, the first and the second lines are detected by the movement sensors.

13. The torque wrench as claimed in claim **11**, wherein the first index has value marks which are matched with the marks on the scale member.

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